

Parkhomchuk v. MONTAUK 26 Sept. ?
 What is limits on the P.S. density N beam?
 (N_0 / ϵ_{6n}) at ionisation cooling.
 $\mu^+ \mu^-$ collider need to have $(3 \cdot 10^{12} / 85 \cdot 10^{-12} N^3) = 3.5 \cdot 10^{22} / N^3$
 cooling : low energy $\gamma \beta \approx 1$

$$\delta_{\perp} = \delta_{\parallel} \approx 3 \text{ mm} \quad \Delta \theta = \sqrt{m_e/m_\mu} \approx 0.07$$

$$\epsilon_{6n} = (\beta \gamma)^3 \cdot \delta_x \Delta \theta_x \delta_y \Delta \theta_y \delta_z \Delta \theta_z \approx (\beta \gamma)^3 \Delta \theta^6 \beta^3$$

$\beta \approx 4 \text{ cm}$ - beta function

$$I_{\text{peak}} = \frac{\beta c}{\delta_{\parallel}} q N_0 \approx 30 \text{ kA}! \quad n_\mu \approx 2.5 \cdot 10^{13} \text{ cm}^{-3}$$

$$\omega_p = \sqrt{\frac{4\pi e^2 n_\mu}{m_\mu}} \approx 2 \cdot 10^{10} \text{ 1/c}$$

detocusing

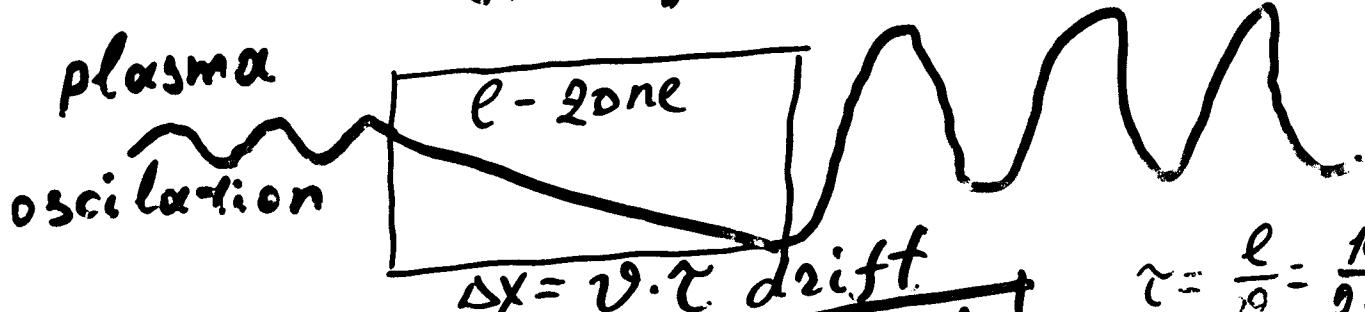
$$\omega_f = \frac{\beta c}{\beta} = 5 \cdot 10^9 \text{ 1/c}$$

focusing

$$E_p = N_\mu \left(\frac{m_\mu v^2}{2} + \frac{m_\mu w_p^2 x^2}{2} \right) = \text{const}$$

$$\Delta E_p = N_\mu \left(-\frac{m_\mu v^2}{2} + \frac{m_\mu w_p^2 (v \tau)^2}{2} \right) / (w_p \tau)^2 \frac{m_\mu}{m_e}$$

cooling heating



$$\omega_{ep} = \sqrt{\frac{4\pi e^2 n_\mu}{m_e}}$$

$$\omega_{rp} = \sqrt{\frac{m_\mu}{m_e}} \omega_p = 2.8 \cdot 10^{11} \text{ s}^{-1}$$

$$\omega_{ep} < \frac{1}{\tau}$$

$$\tau = \frac{l}{v} = \frac{10 \text{ cm}}{2 \cdot 10^{10}} = 5 \text{ ns}$$

$$w\tau = 150$$

$$n_{\perp} < n_\mu \frac{1}{(150)^2} !$$

Distruption parameters

$$E_I = 4\pi n_{i\mu} e X$$

$$\omega_\mu^2 = \frac{4\pi n_\mu e^2}{8m_\mu} \quad \omega_e^2 = \frac{4\pi n_\mu e^2}{8m_e}$$

γ -interaction time

$$\mathcal{D}_\mu = \omega_\mu^2 \gamma^2 \quad \mathcal{D}_e = \omega_e^2 \gamma^2$$

$$\mathcal{D}_e = \mathcal{D}_\mu \cdot \frac{8m_\mu}{m_e}$$

For non relativistic ion ring

$$\mathcal{D}_e = \mathcal{D}_i \cdot \frac{M}{m_e} = D_i \cdot 2000 \cdot \frac{A}{8}$$

Pickup
Disk 16

Show data from Lecroy oscilloscope
23 april 1998

M := READPRN(sc1012)

i1 := 2..rows(M) - 1

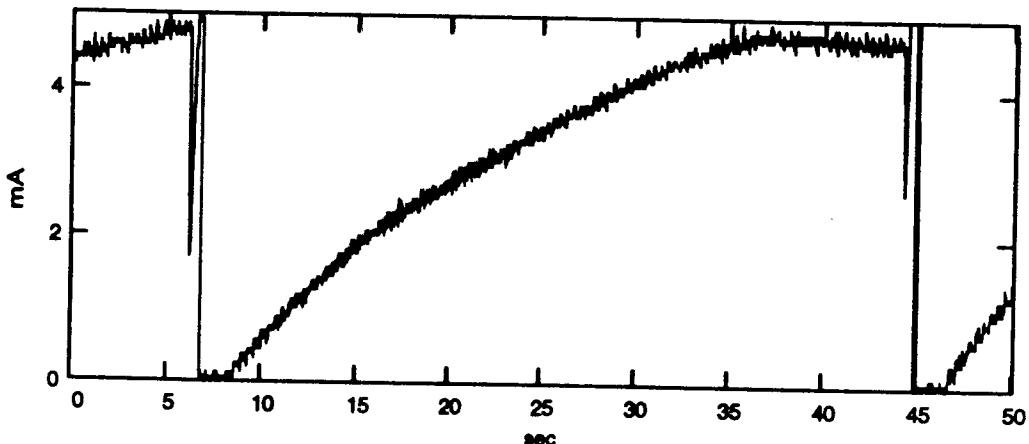
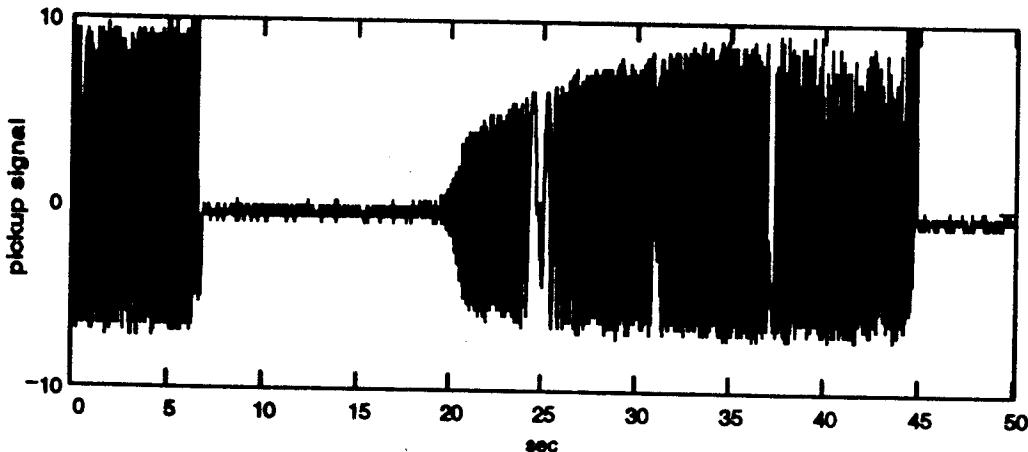
t1 := M<0> A1 := M<1> A1 := A1·10

Show data from Lecroy oscilloscope
23 april 1998

M2 := READPRN(sc2011)

i2 := 2..rows(M2) - 1

t2 := M<0> A2 := M2<1> A2 := A2·10



Accumulation with electron current 800mA - upper fig. signal from pickup electrodes
show increasing longitudinal fluctuation at beam after accumulated ion current 2.5 mA.,
at low fig. shown that after beginning this self bunching fluctuation accumulation rate
drop down.

$$PC = A \gamma \beta M_p C^2$$

200 ~1 1 GeV

200 GeV/c